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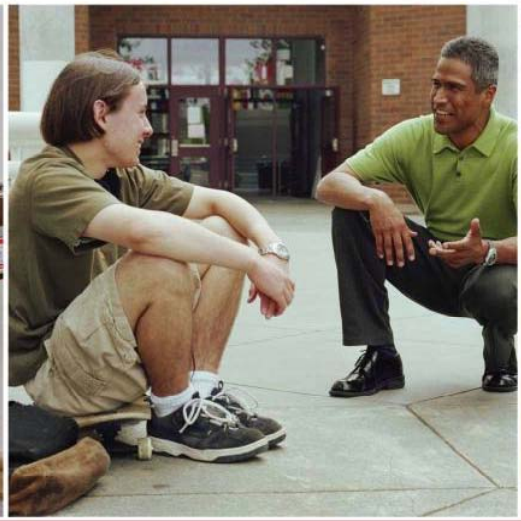
Building the Future: An integrated strategy for nursing human resources in Canada


NURSE HUMAN RESOURCE REQUIREMENTS IN CANADA: IMPLICATIONS OF CHANGES IN SERVICE DELIVERY

This report is part of an overall project entitled **Building the Future: An integrated strategy for nursing human resources in Canada**.

Nurse Human Resource Requirements in Canada: Implications of Changes in Service Delivery

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Preface

This report is part of an overall project, **Building the Future: An integrated strategy for nursing human resources in Canada**. The goal of the project is to create an informed, long-term strategy to ensure that there is an adequate supply of skilled and knowledgeable nurses to meet the evolving health care needs of all Canadians. Through surveys, interviews, literature reviews, and other research, Building the Future will provide the first comprehensive report on the state of nursing human resources in Canada. The project comprises the following two phases.

Phase I: Research about the nursing labour market in Canada is being conducted in stages. Reports will be released as the research work is completed to share interim findings and recommendations with the nursing sector. A final report will be produced at the conclusion of this phase that will include all of the recommendations accepted by the Nursing Sector Study Corporation.

Phase II: A national strategy will be developed in consultation with government and non-government stakeholders that builds on the findings and recommendations presented at the completion of Phase I.

To oversee such a complex project, the Nursing Sector Study Corporation (NSSC) was created in 2001. The Management Committee of NSSC comprises representatives of the signatories to the contribution agreement with the Government of Canada and other government groups.

The multi-stakeholder Steering Committee for the project comprises approximately 30 representatives from the three regulated nursing occupations (licensed practical nurse, registered psychiatric nurse, and registered nurse), private and public employers, unions, educators, health researchers, and federal, provincial and territorial governments. The Steering Committee guides the study components and approves study deliverables including all reports and recommendations.

Members of the Management Committee and the Steering Committee represent the following organizations and sectors.

Aboriginal Nurses Association of Canada
Association of Canadian Community Colleges
Canadian Alliance of Community Health Centre Associations
Canadian Association for Community Care
Canadian Association of Schools of Nursing
Canadian Federation of Nurses Unions
Canadian Healthcare Association
Canadian Home Care Association
Canadian Institute for Health Information
Canadian Nurses Association
Canadian Practical Nurses Association
Canadian Union of Public Employees
Health Canada
Human Resources and Skills Development Canada
National Union of Public and General Employees
Nurse educators from various institutions
Ordre des infirmières et infirmiers auxiliaires du Québec
Ordre des infirmières et infirmiers du Québec
Professional Institute of the Public Service of Canada
Registered Psychiatric Nurses of Canada
Representatives of provincial and territorial governments
Service Employees International Union
Task Force Two: A human resource strategy for physicians in Canada
Victorian Order of Nurses Canada

Together, we are committed to building a better future for all nurses in Canada and a better health system for all Canadians.

1. Introduction

Human resource planning (HRP) is a complex process of attempting to match the supply of human resources with the requirements for those resources. In the health care sector in Canada, the focus of HRP policy to date has been on the impact of demographic change on requirements for individual health care professions, i.e., the effect of an aging population on the requirements for particular health care providers and the effect of an aging workforce on total service provision by the particular provider groups (Denton et al., 1993, 1994, 1995; Birch et al., 1994; Ryten, 1997; Kazanjian, 2000; RNAO & RPNAO, 2000; Kazanjian et al., 2000). The analyses of these factors have tended to focus on estimating shortfalls or surpluses in provider groups and discussing the implications for proposed changes in the size of education programmes.

1.1. Research Question

The need for nurses cannot be determined in isolation of broader considerations of dynamic changes in population epidemiology and the production of health care services. In this report, we seek to illustrate the significance of these broader considerations and provide an evidence base for decision-makers concerned with planning the future supply of nurse human resources. In particular, we address the following questions.

1. How have the levels of need for health care services in the population changed over the last decade?
2. How have the ways human and non-human health care resources been used in the production of health care services changed over the last decade?

2. Methods

2.1. Literature Search

As stated earlier, the approach to human resource planning in Canada has been to focus on a) the impact of demographic change on requirements for individual health care professions and b) the effect of an aging workforce on total service provision by the particular provider groups. The ensuing analyses tend to focus on estimating shortfalls or surpluses in provider groups and discussing the implications for proposed changes in the size of education programmes.

Several research reports have highlighted limitations of these approaches, and recommendations have been made for improving the analysis (Birch et al., 1994; Lomas et al., 1985; Barer et al., 1991; Birch, 2002). In particular, the reports have highlighted the endogenous nature of health care requirements, that is, they are conditional on the values and structures of health care systems, which are political or social choices. For example, consider two populations with identical health profiles but different health care systems. In the first population, health care is publicly funded and access to services is allocated on the basis of health care needs. In the second population, funding of health care is predominantly private with access to services being allocated on the basis of ability and willingness to pay for services, irrespective of needs for care. The determinants of human resource requirements differ between the two populations, with epidemiology being the determining factor in the first population and economic factors determining requirements in the second population. Only where the social choices about the access to and delivery of care are known can we use scientific methods in a meaningful way to derive the health care requirements for a particular population.

Various approaches have been developed for estimating human resource requirements based on the particular nature of the various health care systems (Birch et al., 1994; Markham et al., 1997). Nevertheless, these approaches have generally been concerned with refining existing approaches and have remained focused on applying what individual professions currently provide and the way they currently provide care to the future projected population. As a result, HRP continues to be largely an exercise in demography based on implicit assumptions that population age structure determines the service needs of the population and that the age of providers determines the quantity of care provided (Nova Scotia Department of Health, 1999; Advisory Committee on Health Human Resources, 2000).

Such approaches fail to reflect two key features: the *complex nature* of the processes underlying both the *needs* for services (population health) and the *delivery* of services (health care provision), as well as the *effects of health human resource planning* on population, provider and system outcomes. Both population health and health care provision represent production processes in which outputs are produced from a combination of different inputs. The health human resource planning processes used to date largely assume that the relationships between age and needs and between the numbers of providers and the quantity of service outputs are exogenous, independent of other factors, and hence constant over time. However, if epidemiology and production processes are not *fixed* in time, then health human resource planning based on these assumptions will estimate human resource requirements inaccurately (Birch et al., 1994). For example, Chernichovsky and Markowitz (2004) note that despite documented improvements in health status among populations over time, per capita spending on health care has continued to rise.

The production function represents the relationship between quantity of inputs used and the quantity of output produced from those inputs. The output of health care services produced from a given number of providers will depend on many factors (Gray, 1982; O'Brien-Pallas et al., 2001a,b). For example, health human resource planning studies have tended to consider the characteristics of the stock of health care providers based on observations that the quantity and type of services produced by health care providers are associated with the age and gender distribution of that stock, as well as other factors such as the place and period of training. In this way, health care providers are viewed as a heterogeneous group of human resources, and the flow of health care services associated with the stock of health care providers is estimated on the basis of the size and characteristics of the stock.

However, the determinants of service outputs are not confined to the characteristics of health human resources. A given category of human resource (e.g., nurses) does not provide care in isolation. Rather, they use their knowledge and skills in combination with other human and non-human resources to provide services to meet the needs of the population. The way in which different inputs combine to produce health care services represents the technology of the production process. In principle, we would want to use that combination of inputs (i.e., technology) that minimises the cost of producing the required services. However, the availability of particular inputs may constrain the range of technologies that can be used. For example, the availability of hospital facilities may differ between two populations with identical health care needs. But the number of surgical procedures that an operating room nurse can support may depend on, among other things, the availability of operating room time and surgeons. So, the number of nurses required to meet the health care needs will be determined by the level and mix of other human and non-human resources, which may differ between the two populations.

Innovation in production involves new or modified ways of production based on producing more (or the same) outputs using the same (or fewer) inputs. From the perspective of health human resources planning, innovation may change the resource requirements associated with a particular level of service output. The effect on particular resources will depend on the nature of the innovation. The adoption of a new method of delivery of services may lead to the requirements for a particular input to increase, decrease, or stay the same.

The case of dentistry in the UK provides an example of how changing needs and changing production processes influence the need for health human resources. Levels of oral health increased dramatically over the late 1960s and 1970s associated with increased fluoridation of water supplies, improved oral hygiene, and changes in diets. As a result, the average need by age group for dental care (and hence dentists' time) fell. During the same period, innovation in the delivery of dental care — in the form of multiple chair dentistry — was associated with a significant increase in the level of dental care services provided by a given stock of dentists (Birch and Maynard, 1985). In terms of human resource requirements, fewer dentists would be required to provide the same level of service delivery given the increased provision of dental assistants and dentist chairs (Birch et al., 1985).

Traditionally, HRP research has failed to consider the dynamic nature of the production of health care services. The technology of health care production has implicitly been assumed to remain constant over time. In addition, the availability of other health care inputs has been assumed to be perfectly elastic and hence not a constraint on the activities and productivity of the particular human resource being studied. In other words, the analyses have been based on the assumptions of fixed coefficients of production such that a particular level of health care need translates into a particular number of required physicians, nurses, or other health care providers. Under traditional approaches, this requirement for providers is invariant over time and independent of the availability of all other health care inputs.

Over the last decade, major changes have occurred in the delivery of health care services. For example, there has been a major shift in the balance of care away from inpatient and institutional settings towards outpatient and community and home settings. Because these various approaches to service delivery involve different levels and mixes of resources, the changing balance of care will have implications for the requirements for human resources. Denton et al. (1995) attempted to incorporate this shift in the balance of care into their estimates by performing sensitivity analysis on their estimates of nursing human resource requirements for Ontario. In particular, they considered the effect on their estimates of assuming an arbitrary reduction in inpatient days per annum of 10% across all population age groups. This led to a 30% reduction in the estimated shortfall of nurses by 2010. Although this study provided an important illustration of the sensitivity of estimated requirements to the underlying methods of production, it was not based on an explicit model of production. No consideration was given to the methods of care delivery — and hence the requirements for other inputs — to support the assumed reduction of length of stay of 10% for all patients. Instead, it was assumed that the required number of nurses for the delivery of inpatient care changes in proportion to the number of bed days.

2.2. Population Health Care Needs

No simple single measure of population health care need exists. Instead there are four broad categories of health indicators that reflect population health care needs: mortality, morbidity, health risks, and self-assessed health status. Each category has strengths and limitations as indicators of the need for health care services in a population (see Eyles et al., 1993, for the relative merits of each). However, each provides a helpful marker for assessing change in needs over time. For the purposes of this report, we selected eight indicators of population health (within the four categories) and reported on the numbers related to those indicators for particular age groups, for both 1991 and 2000 (with the exception of 1999 for mortality). We have also indicated the percentage change between those two years. (See Appendix C.)

Population-based **mortality** data are derived from the records of the offices of registrar general of each province. Data on **morbidity, health risks, and self-assessed health status** are derived from the national population health surveys based on randomly selected samples of the population of Canada. Both are available from Statistics Canada.

2.3. The Production of Health Care Services

Traditionally, the number of nurses required has been calculated in relation to the size of the population. However, this fails to consider the activities of nurses and the other resources available to support them in these activities, as well as developments in health care technology and changes in the way health care is delivered. In order to better understand the role of nurses in the production of services, we consider the trends over time regarding the number of nurses in relation to health care services being produced, along with other resources employed in the production of those services. Although in principle we set out to consider separately the various sectors in which nurses are employed, constraints on the availability of data meant that our attention was restricted to the acute hospital sector and in particular the production of episodes of inpatient care. In particular, we wanted to assess the change in the contribution of nurses to the production of inpatient episodes.

Data were provided by the Canadian Institute for Health Information (CIHI) based on the clinical data from the *Discharge Abstract Database* and administrative hospital data from the *Canadian Management Information System Database* (CMDB). Data for each province were available only from

1995 onwards. Hence the trends in the deployment of resources and output of services were considered for the period 1995–2001 only. Even within this restricted period of observation, the quality and completeness of data items varied among provinces.

2.4. Data Quality and Limitations

The Production of Health Care Services. The nature of the particular data items in some cases presented a limitation regarding the interpretation of reported trends. As stated above, even within the restricted period of observation, the quality and completeness of data items varied among provinces. In particular, **data on hospital beds** were based on the rated bed capacity of hospitals as opposed to the actual number of beds available for use by hospitals, while **data on the number of FTEs** (full-time equivalents) providing nursing care were available only at an aggregate level that combined all types of nurse (RNs, LPNs, and RPNs). As well, for **data on inpatient nurse FTEs**, only in Ontario was the hospital reporting rate above 95% (range was 95.25–97.3%) for the entire period; the rates for other provinces varied substantially (e.g., British Columbia 89.45–98.8% and PEI, 0–100%). **In the case of other inputs**, the scale of this problem was even greater.

In line with the original mandate for the report, we report trends for each province as well as for Canada as a whole; however, we emphasize that only for Ontario are the data based on reasonable and consistent levels of reporting. Given that the experience of Ontario may not represent that of other provinces, we recommend that the data for other provinces, and for Canada as a whole, not be used at this stage to inform policy discussions regarding such items as future nurse requirements. Rather, the trends observed in this report should be viewed as illustrative of underlying patterns of service delivery only and thus form the basis for further analysis using more specific data.

3. Data Findings

3.1. Population Health Care Needs

The table in Appendix C reports the level of various indicators of population health by age group and gender for 1991 and 2000 (1999 for mortality rate), as well as the percentage change in the indicator over that period. A consistent picture emerges that health has improved over this period for most age groups. In the case of mortality per 1,000 population, only among older women has the rate increased, and even then the increase has been less than 1% over the period of observation. Although mortality is not a good measure of need for health care at the individual level (i.e., health care is of no benefit to the deceased), it does provide a good indicator of risks to health at the population level (e.g., those living in areas of higher mortality may have increased needs for health care than those living in areas of lower mortality).

At least part of this reduction in mortality would appear to be associated with changing risks to health. For example, there has been a fairly consistent increase in the number of individuals across all age and gender groups reporting that they do not smoke. Similar trends are observed for the reporting of high blood pressure. The proportion of individuals reporting no problems with blood pressure has increased in all groups except for those aged 75+ and for women aged 65–74. However, this may be explained by an increasing prevalence of testing and reporting for high blood pressure in these groups as opposed to a true increase in prevalence. The data on morbidity indicate a substantial reduction in arthritis, rheumatism and heart disease in all age-gender groups, but a substantial increase in the prevalence of diabetes (with the exception of a substantial reduction in diabetes among young women).

Measures of morbidity that are related to medical diagnoses are influenced by the level of supply of health care services, since, in order to be diagnosed with a condition, one first needs to have access to a health care provider. Hence, these measures may underestimate true morbidity if problems with access to services mean that some morbidity in the population remains undiagnosed. However, we are primarily concerned with *trends* in morbidity in this report. It seems implausible that the reported trends could be explained by changes in access to services, particularly since the various measures of morbidity exhibit fundamentally different trends. Thus, the *morbidity* data presented in this report represent examples of trends in the *reporting* of specific health conditions and must be considered in combination with the reported trends in mortality, health risks, and self-assessed health.

Turning to self-assessed health, an interesting age pattern emerges. Among younger age groups, a substantial improvement in health is observed with fewer reporting health as poor or fair and more reporting health as excellent. In middle-age groups, the trend seems to be towards the mid-range categories (very good or good health) with fewer reporting health as either poor/fair or excellent. In the older age groups, however, there is a trend towards poorer health, with a greater proportion of individuals reporting health as fair or poor and fewer reporting health as excellent. In comparison to the other health indicators reported in the table in Appendix C, **self-assessed health** is much more subjective. Given the absence of any clear trend towards poorer health in the more objective indicators of health, this lower level of self-assessed health among elderly groups might reflect changing expectations about health among these groups. Nevertheless, since expectations about health are an important factor in the demand for health care, this trend should not be ignored in considering the future provision of health care.

In summary, there is substantial evidence of improvement in health and reductions in risks to health in the Canadian population over the last decade of the 20th century. However, there is evidence of

an increase in diabetes in all adult age groups (with the exception of young women) and of a downward trend in subjective health among the elderly.

It is important to note that trends showing improvements in health among all age groups do not necessarily indicate that less health care is needed. Even if the level of health care needs for the average 65 year old is reduced, this has to be considered in conjunction with the increase in the size of the population aged 65, as well as any policy directions for improving access to services, etc. Nevertheless, these trends suggest that the assumptions underlying traditional approaches to health human resources planning — assuming constant levels of age-specific needs for care — may result in an overestimation of the requirements for health human resources generally, and for nurses specifically.

3.2. The Production of Health Care Services — Ontario Data

Data on the selected health care resource inputs and the output of selected services for the period 1995–2001 are reported in the table in Appendix D. As mentioned above, only for Ontario are the data based on consistent and reasonably complete records. The following section, therefore, will be restricted to discussion of the Ontario data.

3.2.1. Health Care Resources — Input

As shown in the table in Appendix D, there was a reduction in the number of beds of almost 20% in acute care hospitals between 1995 and 2001 in Ontario. This contrasted with an increase in all other human resources inputs, although the increase was proportionately much smaller for inpatient nurses than for each of the other categories. In other words, inpatient nursing represented a declining proportion of all hospital human resources.

The rate of increase in inpatient nursing (4.8%) lagged behind the increase in the size of the population (8.7%) and hence nurse-to-population ratios fell. However, as noted above, there appears to have been an increase in the health of the population, indicating that the need for health care per 1,000 population may have fallen. As a result, it is more meaningful to consider the changing levels of health care resources in the light of the changes in what is being produced, i.e., episodes of care and patient visits.

3.2.2. Health Care Services — Output

As can be seen in the table in Appendix D, the number of inpatient episodes in Ontario fell by more than 12% during the period of study. One interpretation is that because the number of episodes of care fell at the same time the number of inpatient nurses increased, hospitals were deploying an inefficiently high number of nurses. However, this fails to consider what lay behind the reduced episodes of care. Because the availability of beds was reduced, decisions had to be made about the use of the lower numbers of beds, i.e., which types of patients would continue to be admitted as inpatients and which would be served in other ways. In order to deal with this reduced capacity to provide inpatient episodes of care, admission and discharge criteria were altered with admission to hospital requiring on average a higher level of need (or severity) with lesser needs being referred to alternative services (e.g., day surgery, outpatient services). If this is the case, then the crude number of episodes of care would misrepresent the real demands on health care resources as it does not allow for changes over time in the average severity of inpatients.

To allow for variations in severity, episodes of inpatient care were adjusted using data on resource intensity weights (RIW) of cases; as a result, more severe cases, i.e., those requiring more resources, were weighted greater than less severe cases. As the average level of severity of cases increased, the level of adjusted cases also increased. Thus, as can be seen in the table in Appendix D, while the non-adjusted (crude) rate showed a reduction of -12%, the adjusted rate showed an increase of 8%. This provides a more meaningful measure of service output than the non-adjusted number of episodes. Note that this 8% increase in the total volume of inpatient care exceeds the 4.8% increase in inpatient nurse human resources (FTEs). As well, adjusted episodes per bed increased by almost 40%, and adjusted episodes per nurse by over 4%. In other words, hospitals had an 8% increase in the true (adjusted) volume of care being produced, using 20% fewer beds and only 4.8% more nursing inputs.

It should be noted that all human resource **inputs** other than nursing increased over this period and at rates in excess of the increase in adjusted inpatient episodes. However, there is no way of identifying the *inpatient* component of these activities, as is done with nursing data. Moreover, the **output** of services other than nursing also increased, with the exception of emergency department visits. With regards to day surgery cases, the rate of increase was more than three times that of adjusted episodes. Moreover, since much of this increase is likely to have come from the reduction in inpatient episodes (i.e., a shift of inpatient surgery to day case clinics), the average severity of these cases is also likely to have increased. This can be seen in the increase in adjusted day case surgery for Ontario for 1995–2001, which was 30% — that is, 5% greater than the increase in crude numbers of cases over the same period (data not included in the table in Appendix D).

4. Discussion and Recommendations

In this report, we have identified the importance of going beyond looking simply at demographic change when considering the development and application of models of health human resources planning. We have shown that health human resource planning needs to be broadened to include the context of both the production of health in populations and the production of health care services. By adopting this broader focus, health human resources planning can consider how innovations in the production and delivery of health care services change the role, and hence requirements, for human resources, independent of (or in addition to) changes in requirements arising from changes in the needs for health care services.

Although our analysis of trends in health was based on data for all of Canada, the discussion of trends in health care resources and services was restricted to the province of Ontario because of major limitations in the data for other provinces; hence, those findings may not apply to other provinces. However, the general trends of reductions in the number of acute care beds, reductions in the average length of stay, and the reported shortages of nurses are common to many jurisdictions. Although the flexibility associated with the employment of nurses and other human resources may differ among health care systems, this does not detract from the importance of planning human resources in the context of other policy developments, which impact directly on health care inputs.

Although nursing input per inpatient episode in Ontario increased during the period of study, the increase is nonetheless associated with, or possibly results from, the major reductions in inpatient episodes. Moreover, nursing input per inpatient episode actually fell over this period once we allowed for the increasing severity of those patients admitted to hospital. This finding is consistent with an analysis of patient complexity data over the same period (O'Brien-Pallas et al., 2001c).

This finding might help explain the reported work–life issues among nurses, including problems of "burnout" and the associated challenges of nurse retention. Patient care workloads that exceed the capacity of nurses to provide the required levels of care have been reported as major workplace concerns of nurses in several countries (Aiken et al., 2001; Baumann et al., 2001). Based on our findings, it may be that the hospital restructuring initiative in Ontario in the mid-1990s led to a misallocation of resources. Inadequate numbers of nurses were employed in acute care hospitals to provide the increased intensity of care resulting from the policy of reducing beds while striving to continue to meet the health care needs of the population. In addition to the implications for nurse requirements in acute hospitals, the policy on bed reduction also had implications for the community-based services: patients with below-average needs in an acute care setting were relocated to the community, where their needs may have been considered above-average for that setting.

It should be noted that there is no reason to believe that the way resources are currently used in the delivery of inpatient care is efficient. In other words, although we observe that the rate of reduction in the numbers of nurses was less than the rate of reduction in the number of inpatient episodes, this does not imply that the level of reduction in nurses was necessary or sufficient to support the efficient delivery of inpatient care with the lower number of hospital beds. The identification of an efficient mix of inputs should be considered using data envelopment analysis or stochastic frontier modelling (Hollingsworth, Dawson & Maniadakis, 1999). For example, Tambour (1997) uses both these approaches to analyze changes in the delivery of services by hospital opthalmology departments in Sweden. The findings can be used to estimate the effect of changing models of delivery on the requirements for a range of health care resources, including physicians and nurses.

These approaches require data collected at the level of the unit of production (hospital or ward); these data are currently not available in Canada, in particular, the use of nurses in the provision of inpatient services. However, even if unit level utilization data were available, there remains the question of whether it is prudent to base plans for human resources on the efficient use of those resources without having the means available to ensure that *all* areas of health care production use efficient methods of production. In other words, health human resources planning cannot be performed effectively if it is performed in isolation of broader health care policy processes (O'Brien-Pallas et al., 2001a, b; CIHI, 2001).

Human resources have been identified as the dominant health policy issue in Canada (CHSRF, 2001a, 2001b). However, the debate over human resources has continued to be based on the implicit assumption of fixed coefficients of production. For example, the Registered Nurses Association of Ontario and the Registered Practical Nurses Association of Ontario estimated that between 60,000 and 90,000 new recruits would be required for nursing in Ontario by 2001 (RNAO & RPNAO, 2000). However, these estimates were based on implicit assumptions that both the age-specific needs for health care and the methods of production and delivery of services would remain constant over this period. Similarly, the Canadian Health Services Research Foundation saw the failure to increase the supply of nurses in line with the increase in the size of the population as a major problem for nurse human resources (CHSRF, 2001a, 2001b). No attempt was made to justify the appropriateness of the current nurse-to-population ratio, or to relate this to ratios for previous years. Nor was any consideration given to the changing role of nurses in the production and delivery of care or the changing needs of the population over time.

The main message of this report is that research in health human resources planning will need to go beyond demography if we are to avoid replicating the cycles of boom and bust in the availability of human resources. While health policy makers generally consider demographic change in the population to be an exogenous variable in health human resources planning, the methods of production and delivery of services are considered endogenous. In order to produce more meaningful estimates of future requirements for human resources, decision-makers need to pay greater attention to the current plans and developments in the production and delivery of health care, as well as to the continuing developments in the levels and distribution of needs in the population.

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Appendix A. Acronyms

See Appendix E for acronyms used for provinces and territories.

CIHI .....Canadian Institute for Health Information
CMDB.....Canadian Management Information System Database
FTE .....full-time equivalent
HRP.....human resources planning
LPN.....licensed practical nurse
RIW.....resource intensity weight
RN.....registered nurse
RPN.....registered psychiatric nurse

Appendix B. Glossary of Key Terms

Note: This glossary is meant to indicate only how the following terms are used in this report. It is not meant to provide comprehensive definitions.

crude. Refers to number of episodes without adjusting.

episodes (of care). The number of admissions.

adjusted episodes. Refers to the number of episodes after the resource intensity weights have been factored in.

human resource inputs. Labour hours involved in providing care.

human resource outputs. The services themselves (i.e., inpatient episodes).

individual health care professions. Refers to nurses, doctors, laboratory technicians, etc.

production function. The relation between inputs and outputs.

production of health care services. Refers to the process of producing health care services (general practitioner visits, episode of care, outpatient care, etc.)

production of health in populations. Includes consumption of services, lifestyle factors, genetics, and population exposures.

resource intensity weights (RIW). A measure of the actual resources required.

sensitivity analysis. Refers to analysis done on estimates of nursing human resource requirements, using changes in assumptions to examine the effect on estimation of outcomes.

stochastic frontier modelling. A methodological approach for estimating production relationships.

technology Regarding health care production, or relating to the production process, refers to the way in which different inputs combine to produce health care services.

weighted. See *adjusted episodes*.

Appendix C. Health Indicators in Canada, by Age and Gender, 1991 & 1999/2000

			15–24 yrs		25–44 yrs		45–64 yrs		65–74 yrs		75+ yrs	
			M	F	M	F	M	F	M	F	M	F
			Negative health indicators									
Mortality	Deaths per 1,000 pop.	1991	1.1	0.3	1.5	0.7	7.9	4.4	30.9	16.5	93.9	67.6
		1999[a]	0.8	0.3	1.3	0.7	6.1	3.7	27.1	15.2	90.6	68.2
		% Change	**-22.9**	**-5.9**	**-11.3**	**-2.7**	**-23.4**	**-17.3**	**-12.5**	**-7.9**	**-3.5**	**0.9**
Morbidity	Arthritis/ Rheumatism	1991	2.3	6.8	10.0	12.6	29.1	41.7	47.7	58.0	52.7	65.7
		2000	1.7	3.1	6.8	9.6	19.5	30.7	33.2	48.5	39.3	54.8
		% Change	**-26.1**	**-54.4**	**-32.0**	**-23.8**	**-33.0**	**-26.4**	**-30.4**	**-16.4**	**-25.4**	**-16.6**
	Heart Disease	1991	1.6	2.2	2.7	2.8	10.0	8.5	21.2	20.1	31.0	29.5
		2000	0.5	0.7	1.2	1.1	7.5	4.8	20.3	15.0	27.6	24.0
		% Change	**-68.8**	**-68.2**	**-55.6**	**-60.7**	**-25.0**	**-43.5**	**-4.2**	**-25.4**	**-11.0**	**-18.6**
	Diabetes	1991	0.4	1.3	1.5	1.6	5.4	5.0	11.0	9.4	11.3	9.3
		2000	0.5	0.5	1.6	1.8	7.0	5.7	15.1	11.5	15.3	11.4
		% Change	**25.0**	**-61.5**	**6.6**	**12.5**	**29.6**	**14.0**	**37.3**	**22.3**	**35.4**	**22.6**
Self-assessment	Fair/Poor Health	1991	6.4	9.6	9.8	8.4	17.4	19.7	26.7	25.6	31.3	32.4
		2000	4.9	6.4	7.4	8.1	16.8	16.9	28.0	24.5	38.1	34.4
		% Change	**-23.4**	**-33.3**	**-24.5**	**-3.6**	**-3.4**	**-14.2**	**-4.9**	**4.3**	**21.7**	**6.2**
			Positive health indicators									
	Excellent Health	1991	25.1	21.0	25.5	27.3	22.8	22.8	14.0	16.0	11.1	8.9
		2000	31.3	22.9	28.4	28.8	21.2	20.1	13.9	12.2	8.2	8.4
		% Change	**24.7**	**9.0**	**11.4**	**5.5**	**-7.0**	**-11.8**	**-0.7**	**-23.8**	**-26.1**	**-5.6**
Risk Factors	Not Smoking	1991	65.6	64.6	62.4	64.2	68.7	69.5	77.8	81.6	85.8	89.5
		2000	67.8	66.8	62.3	67.2	69.5	73.9	82.7	84.0	89.3	92.3
		% Change	**3.4**	**3.4**	**0.2**	**4.7**	**1.2**	**6.3**	**6.3**	**2.9**	**4.1**	**3.1**
	No High Blood Pressure	1991	95.8	96.7	87.2	92.0	74.5	74.5	65.2	60.0	71.7	55.4
		2000	99.0	98.8	94.7	95.5	81.3	78.9	66.9	59.8	65.9	54.0
		% Change	**3.3**	**2.2**	**8.6**	**3.8**	**9.1**	**5.9**	**2.6**	**-0.3**	**-8.1**	**-2.5**

Source: Statistics Canada**:** Mortality data are from the provincial offices of the registrar general; morbidity, risks, and self-assessed health status data health are from national population health surveys based on randomly selected samples of the population of Canada.

[a]Data not available for 2000.

Appendix D. Change in Health Care Resources and Services, by Province, 1995–2001

		BC	AB	SK	MB	ON	QC	NB	NS	PE	NL	YT	NT	CAN
		% change												
Input (Resources)	Inpatient beds (rated capacity)	1.5	-13.0	-46.8	-5.9	-20.0	-30.0	3.0	-9.1	1.3	-14.0	-58.0	-11.0	-19.0
	Inpatient nursing FTE	8.6	54.4	693.0	184.8	4.8	-0.3	-12.0	42.6	—	123.0	—	72.5	19.9
	Outpatient nursing FTE	41.9	81.2	8,018.1	145.0	20.7	57.7	5.7	109.0	—	152.0	—	24.4	49.7
	Housekeeping FTE	8.3	51.0	358.3	123.0	7.6	-11.0	3.6	18.7	—	46.4	—	-42.0	13.7
	Physiotherapy FTE	-1.2	70.0	1,226.8	187.4	3.3	-4.0	-1.3	22.3	—	-34.0	—	-19.0	13.9
	Occupational therapy FTE	-5.0	79.7	23,942.0	106.4	32.2	40.5	7.9	20.9	—	80.1	—	-5.7	35.4
	Social work FTE	3.5	23.9	3,283.1	93.9	28.4	-100.0	19.9	-15.0	—	-44.0	—	5.6	-8.8
	Other allied health FTE	24.0	54.2	1,519.5	170.8	8.7	4.5	13.3	3.1	—	26.1	—	49.2	20.9
Output (Service)	Inpatient episodes	-15.0	-1.8	-5.9	-12.7	-12.0	—	-12.0	-19.0	4.1	-20.0	-11.	-34.0	-11.0
	Adjusted [a]	*-4.2*	*15.6*	*-4.7*	*-6.4*	*8.0*	—	*5.3*	*-8.7*	*13.3*	*-12.0*	*10.4*	*-28.0*	*4.1*
	Day surgery cases	12.8	—	58.0	-4.6	25.3	—	42.9	27.5	-62.0	80.1	-2.6	16.6	-0.1
	Clinic visits	-8.9	31.2	-8.9	5.3	3.8	-80.0	-26.0	46.0	113.0	-25.0	-39.0	-4.1	-25.0
	Emergency visits	-11.0	-1.1	-1.2	10.4	-0.5	-24.0	-5.1	9.7	4.0	-0.8	-11.0	-11.0	-6.6
Productivity [b]	Inpatient episodes per bed	-18.0	14.5	54.2	0.2	12.2	—	-12.0	-9.6	-71.0	-6.3	64.3	-26.0	-3.3
	Adjusted [a]	*-7.3*	*34.0*	*56.2*	*7.5*	*38.0*	—	*5.6*	*2.2*	*-68.0*	*3.3*	*103.0*	*-19.0*	*2.4*
	Inpatient episodes per nursing inpatient FTE	-23.0	-35.0	-91.7	-64.0	-15.0	—	1.8	-43.0	—	-64.0	—	-62.0	-60.0
	Adjusted [a]	*-13.0*	*-24.0*	*-91.6*	*-61.4*	*4.2*	—	*22.4*	*-35.0*	—	*-60.0*	—	*-58.0*	*-57.0*
	Population	8.0	11.8	-1.4	1.9	8.7	2.5	-0.1	0.4	2.2	-7.9	0.0	0.0	5.9

Source: Clinical data are from the *Discharge Abstract Database*, Canadian Institute for Health Information (CIHI); administrative hospital data are from the *Canadian Management Information System Database*.

Note: FTE = full-time equivalent. Only for Ontario are the data based on consistent and reasonably complete records. Population change for Nunavut was 12%; other data were not available.

[a]To allow for variations in severity, inpatient episodes were adjusted using data on resource intensity weights of cases.

[b]Productivity is rate of output per unit input.

Appendix E. Key to Geographical Names and Acronyms

Note: Dates in parenthesis indicate the year the province/territory joined Confederation.

THE NORTH (the territories)
YT Yukon Territory (1898)
NT Northwest Territories (1870)
NU Nunavut (formerly part of NT, until 1999)

Nursing education programs in the territories:

RNs	One in NT.
LPNs	One in YK and NT, offered on an occasional basis every two to three years. It is unknown what percentage the territories contribute to the total LPN workforce.
RPNs	None.

WESTERN CANADA

West Coast
BC British Columbia (1871)

Prairie Provinces
AB Alberta (1905)
SK Saskatchewan (1905)
MB Manitoba (1870)

CENTRAL CANADA
ON Ontario (1867)
QC Quebec (1867)

ATLANTIC PROVINCES

Maritimes (includes Labrador)
NB New Brunswick (1867)
PE Prince Edward Island (1873)
NS Nova Scotia (1867)
****
NL Newfoundland and Labrador (1949) — NF until October 2002

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